The NASA "Why?" Files
The Case of the
Phenomenal Weather

Segment 4

In the tree house, the detectives listen to Dr. Textbook as he describes the history of violent hurricanes. Worried that Hurricane Ichabod could cause damage similar to that of past storms, they decide they need to know how to predict landfall. They dial up a NASA "Why?" Files Kids Club classroom in Vero Beach, Florida. Mrs. Srigley's 5th grade class tells them about the "Hurricane Game" and how watches and warnings are issued. Armed with this new information and a new weather update, the tree house detectives visit the National Oceanic and Atmospheric Administration (NOAA) to learn how meteorologists track and predict real hurricanes. The tree house detectives return to Dr. D's to review what they have learned and make their decision about the trip. They think they have finally "predicted" correctly the future path of Hurricane Ichabod and are confident once they have confirmed it.

Objectives

The students will

- understand the risks associated with natural hazards.
- learn how the tracks of past hurricanes can predict the tracks of future hurricanes.
- learn how high and low pressure systems affect hurricanes.

Vocabulary

quadrant - any of the four quarters into which something is divided by two real or imaginary lines that intersect each other at right angles

warning - a warning that sustained winds 64 knots (74 mph or 119 km/hr) or higher associated with a hurricane are expected in a specified coastal area in 24 hours or less. A hurricane warning can remain in effect when dangerously high water or a combination of dangerously high water and exceptionally high waves continues, even though winds may be less than hurricane force.

watch - An announcement for specific coastal areas that hurricane conditions are possible within 36 hours.

Video Component

Implementation Stratey

The NASA "Why?" Files is designed to enhance and enrich the existing curriculum. Two to three days of class time is suggested for each segment to fully use video, resources, activities, and web site.

Before Viewing

1. Prior to viewing Segment 4 of *The Case of the Phenomenal Weather,* discuss the previous segment to review the problem and what the tree house detectives have learned thus far. Download a copy of the Problem Board from the NASA "Why?" Files web site and have students use it to sort the information learned so far.
2. Review the list of questions and issues that the students created prior to viewing Segment 3 and determine which, if any, were answered in the video or in the students' own research.
3. Revise and correct any misconceptions that may have been dispelled during Segment 3. Use tools located on the web, as was previously mentioned in Segments 1 - 3.
4. Focus Questions - Print the questions from the web site ahead of time for students to copy into their science journals. Encourage students to take notes during the program to answer the questions. An icon will appear when the answer is near.

View Segment 4 of the Video

For optimal educational benefit, view *The Case of the Phenomenal Weather* in 15-minute segments and not in its entirety. If you are viewing a taped copy of the program, you may want to stop the video when the Focus Question icon appears to allow students time to answer the question.

After Viewing

1. At the end of Segment 4, lead students in a discussion of the focus questions for Segment 4.
2. Have students discuss and reflect upon the process that the tree house detectives used to learn about weather and hurricanes. The following instructional tools located in the educator's area of the web site may aid in the discussion: Experimental Inquiry Process Flowchart and/or Scientific Method Flowchart.
3. Choose activities from the educator guide and web site to reinforce concepts discussed in the segment. Pinpoint areas in your curriculum that may need to be reinforced and use activities to aid student understanding in those areas.
4. Wrap up the featured online Problem-Based Learning investigation. Evaluate the students' or teams' final product generated to represent the online PBL investigation. Sample evaluation tools can be found in the Educator's area of the web

site under the main menu topic "Tools."

5. Have students write in their journals what they have learned about weather, hurricanes, and/or the problem-solving process and share their entry with a partner or the class.

Resources

Books

Brandley, Franklyn M.: *Hurricane Watch*. Harper Trophy, 1985, ISBN: 0064450627.

Lauber, Patricia: *Hurricanes, Earth's Mightiest Storms.* Scholastic Inc., 1996, ISBN: 0590474073.

Watt, Fiona and Francis Wilson: *Usborne Science and Experiments: Weather and Climate*. Usborne Publishing Ltd., 1992, ISBN: 0746006837.

Wright, Russell G.: *Hurricane! An Event-Based Science Nodule*. Addison-Wesley Publishing Company, 1995, ISBN: 0201490943.

Careers

city planners
architects
disaster relief volunteer
Red Cross worker

Web Sites

National Oceanic and Atmospheric Administration
A comprehensive web site with information on weather, satellites, oceans, fisheries, climates, and much more. Educational resources for both the teacher and student are also available.
http://www.noaa.gov/

NOAA Weather Radio
The voice of the National Weather Service, NOAA Weather Radio broadcasts National Weather Service watches, warnings, and forecasts and other hazard information 24 hours a day.
http://tgsv5.nws.noaa.gov/nwr/nwrback.htm

Hurricane Tracking Chart
You can download this gif image of the Atlantic Ocean from Nova Scotia to northern South America and the Gulf of Mexico to track Atlantic hurricanes.
http://www.nhc.noaa.gov/gifs/track_chart.gif

Hurricane Basics
This booklet, in pdf format, provides you with the anatomy of a hurricane and the ingredients that make these killer storms come alive. Graphics help the reader understand how the storms form.
http://hurricanes.noaa.gov/pdf/hurricanebook.pdf

Activities and Worksheets

Preparing Posthaste

Research how to prepare for a hurricane using books, magazines, newspapers and web sites and then complete the following scenarios.

Suggested web sites:
http://www.fema.gov/kids/hurr.htm
http://www.usatoday.com/weather/disasters/whurricane.htm

You live in a coastal town on the Gulf of Mexico and hurricane season is approaching quickly. You decide that you are going to be smart this year and prepare early for the possibility of a hurricane. Make a list of supplies that you will gather and items you will take care of to prepare for a possible hurricane.

A hurricane has just formed in the Caribbean and it is moving toward the North/Northwest. What steps should you take to prepare for the possible hurricane?

A hurricane watch has just been issued for your town. Make a list of "must do" items and supplies because the hurricane is approaching quickly.

A hurricane warning has now been issued for your town. What is the best course of action to take?

Decades of Hurricanes

Number of Hurricanes by Category to Strike the Mainland U.S. each Decade

DECADE	CATEGORY 1	2	3	4	5	ALL CATEGORIES	MAJOR 3,4,5
1900-1909	5	5	4	2	0	16	6
1910-1919	8	3	5	3	0	19	8
1920-1929	6	4	3	2	0	15	5
1930-1939	4	5	6	1	1	17	8
1940-1949	7	8	7	1	0	23	8
1950-1959	8	1	7	2	0	18	9
1960-1969	4	5	3	2	1	15	6
1970-1979	6	2	4	0	0	12	4
1980-1989	9	1	5	1	0	16	6
1990-1996	0	3	3	1	0	7	4
TOTALS							
1900-1996	57	37	47	15	2	158	64

Use the chart above to answer the following questions:

1. Which decade had the most hurricanes? _____

2. Which decade had the most Category 1 hurricanes? _____

3. Which decade had the most major hurricanes? _____

4. Which hurricane category is most frequent? _____

5. Which hurricane category is the least frequent? _____

6. What is the average number of hurricanes per decade? _____

7. What is the average number of major hurricanes per decade? _____

8. What is the average number of hurricanes per year? _____

Comparing the Statistics

Deadliest Hurricanes of the 20th Century to Strike the U.S.*

* Information was obtained from NOAA www.nhc.noaa.gov/pastdead.html

Using the chart on the right, shade in the areas affected by each hurricane on the map below. Label with the corresponding rank for each one.

Rank	Hurricane	Year	Category	Deaths
1	TX (Galveston)	1900	4	8,000+
2	FL (Lake Okeechobee)	1928	4	1,836
3	FL (Keys)/S. TX	1919	4	600
4	New England	1938	3	600
5	FL (Keys)	1935	5	408
6	Audrey (SW LA/N TX)	1957	4	390
7	NE U.S.	1944	3	390
8	LA (Grand Isle)	1909	4	350
9	LA (New Orleans)	1915	4	275
10	TX (Galveston)	1915	4	275

1. Which two states had the majority of the deadliest hurricanes? _____

2. How could the hurricane of 1919 strike both the Florida Keys and the southern part of Texas? _____

_____

3. In what part of the century did most of these hurricanes occur? (first 50 years or second 50 years)? _____

Comparing the Statistics

Ten Most Expensive Hurricanes to Strike the U.S. in the 20th Century*

* Information was obtained from NOAA www.nhc.noaa.gov/pastdead.html

Using the chart on the right, shade in the areas affected by each hurricane on the map below. Use a different color for each million-dollar bracket. For example, use red for $26 million, orange for $7 million, yellow for $3 million, and so on.

Rank	Hurricane	Year	Category	Damage
1	Andrew (SE FL/SE LA)	1992	4	$ 26,500,000 000
2	Hugo (SC)	1989	4	$ 7,000,000,000
3	Fran (NC)	1996	3	$ 3,200,000,000
4	Opal (NW FL/AL)	1995	3	$ 3,000,000,000
5	Frederic (AL/MS)	1979	3	$ 2,300,000,000
6	Agnes (NE U.S.)	1972	1	$ 2,100,000,000
7	Alicia (SE TX/N TX)	1983	3	$ 2,000,000,000
8	Bob (NC and NE U.S.)	1991	2	$ 1,500,000,000
9	Juan (LA)	1985	1	$ 1,500,000,000
10	Camille (MS/AL)	1969	5	$ 1,420,700,000

Key

- $26 million
- $7 million
- $3 million
- $2 million
- $1 million

4. Which two states had the most damage ever by a hurricane? _____

5. How could Hurricane Andrew cause damage in Southeast Florida and Southeast Louisiana? _____

_____

6. In which half of the century did these costliest hurricanes occur? (first half or second half)? _____

7. Explain why the deadliest hurricanes occurred in a different part of the century than the most costly. _____

_____

NASA Needs Help!

Problem

To determine the best location on Earth for satellites to focus on for better detection of hurricane formation.

Materials

hurricane data table (p. 60)
hurricane tracking chart (p. 61)
5 different colored pencils

Procedure

1. NASA needs your help with a new satellite that it is developing. You and your team must determine which areas within the Atlantic Ocean are the best areas for the new satellite to focus on to watch for the formation of hurricanes. NOAA has collected the data (listed on p. 60).
2. Using a different color for each year, color the map key.
3. Plot the hurricanes' origins on a hurricane tracking map using the appropriate color for each year.
4. Once the origins are plotted, the map will resemble a scatter plot. Look carefully at the visual display of hurricane origins to determine where to focus the satellites.
5. Each area must be no larger than five degrees of latitude by five degrees of longitude.
6. As you choose the areas where the satellites will focus, think of several reasons for your choices and write them in your science journal.
7. Mark the sites on the hurricane tracking map and present your reasons for your decision to the class.

NASA Needs Help! – Hurricane Data Table

Year	Hurricane	Latitude North	Longitude West
1995	Allison	19.3	85.7
	Erin	22.3	73.2
	Felix	15.5	36.4
	Humberto	13.7	34.3
	Iris	13.3	50.6
	Luis	11.6	29.0
	Marilyn	11.8	52.7
	Noel	12.1	40.6
	Opal	21.1	88.5
	Roxanne	16.5	83.1
	Tanya	26.2	57.9
1996	Bertha	11.0	39.0
	Cesar	12.1	68.1
	Dolly	18.2	83.0
	Edouard	13.2	31.6
	Fran	14.6	44.9
	Hortense	16.1	64.5
	Isidore	11.7	34.2
	Lili	19.6	83.5
	Marco	13.8	78.5
1997	Bill	31.8 6	8.9
	Danny	28.3	91.4
	Erika	12.3	47.1
1998	Bonnie	17.3	57.3
	Danielle	14.2	37.9
	Earl	22.4	93.8
	Georges	10.6	31.3
	Ivan	16.0	32.6
	Jeanne	11.0	19.4

Year	Hurricane	Latitude North	Longitude West
1998	Karl	33.2	60.7
	Lisa	14.2	47.1
	Mitch	11.6	77.9
	Nicole	27.9	29.1
1999	Bret	19.8	94.7
	Cindy	13.6	26.6
	Dennis	22.4	70.0
	Floyd	15.3	48.2
	Gert	14.2	31.9
	Irene	18.5	83.4
	Jose	10.9	52.8
	Lenny	16.4	79.9
2000	Alberto	12.0	22.3
	Debby	13.3	46.8
	Florence	30.4	72.2
	Gordon	22.5	86.7
	Isaac	12.3	25.9
	Joyce	11.5	31.9
	Keith	17.4	84.8
	Michael	29.9	71.8
2001	Erin	13.2	37.5
	Felix	18.6	47.7
	Gabrielle	25.3	84.9
	Humberto	27.9	66.3
	Iris	14.8	64.5
	Karen	34.9	65.3
	Michelle	15.8	83.1
	Noel	37.8	50.3
	Olga	29.5	49.8

NASA Needs Help!

Hurricane Tracking Map

Key

☐ 1995 ☐ 1996 ☐ 1997 ☐ 1998 ☐ 1999 ☐ 2000 ☐ 2001

Watch/Warning

Watch = Hurricane or Tropical Storm conditions expected within 36 hours
Warning = Hurricane or Tropical Storm conditions expected within 24 hours

Lost in a Cyclone

H S T T I T E O N O D A D R O T
U S A E D K C Y P H H D M I H R
R T T T S U T T E E P N R A E O
R L A R E U F G R A V I T Y W P
I F E F A L I H C S T W I C M I
C R P Z D T L E E S U L U M U C
A O C R B N U I N K W E R D N A
N P R H O T A S T E O W A V E L
E A I I H B C V D E M H R F T D
I V C M O S A U T S R T L F S E
L R W I O P T B M U O N W R F P
I E A L G I E B I G K A E J L R
T T M E T E O R O L O G I S T E
R A C A T E G O R Y I O S G G S
E W L O R M G O G U S T J T G S
G E O S T A T I O N A R Y B D I
E H R O R M G O G A S W J S G O
P R E D I C T S I L O I R O C N

Word Bank

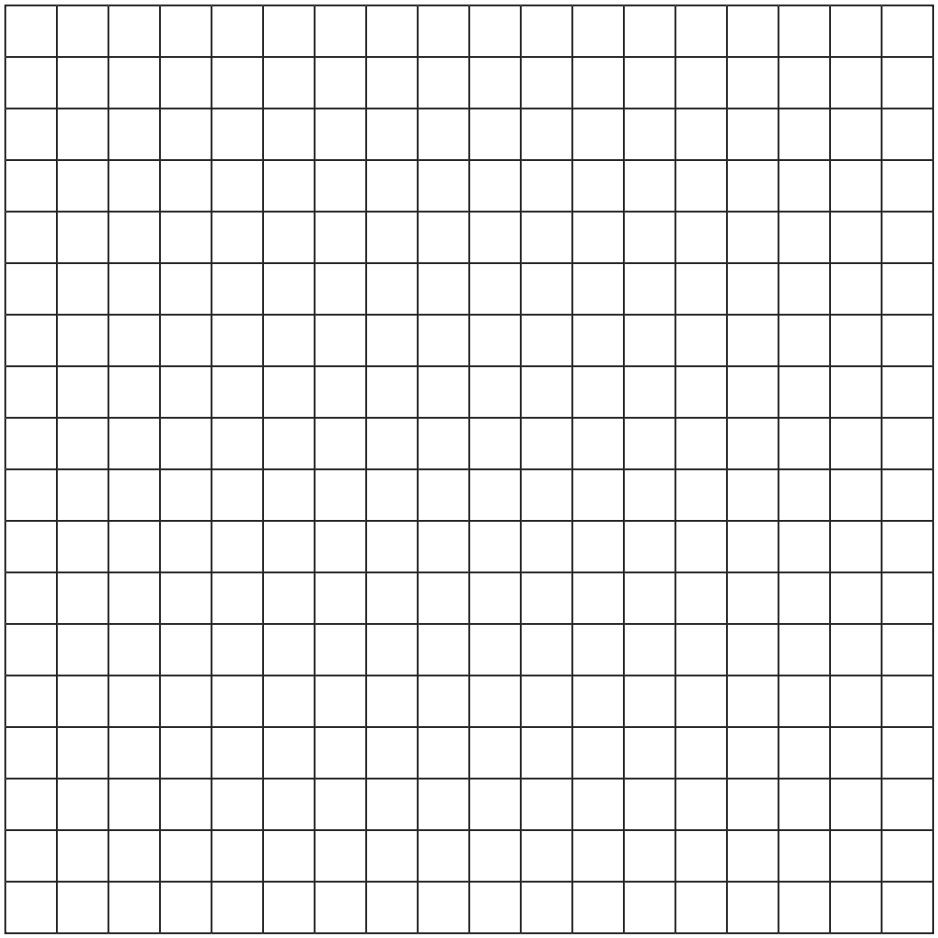
hurricane	probability	gravity	tornado	percent	meteorologist
eye	geostationary	tropical depression	cumulus	latitude	wave
tratus	water vapor	category	satellite	Coriolis	Andrew
predict	wind				

Just a Little Puzzling

Create a crossword puzzle with the following terms and the grid below.

Vocabulary

hurricane	tropics	tornado	LIDAR	satellite
longitude	polar orbiting	latitude	cirrus	GIFTS
meteorologist	probability	Coriolis effect	prediction	gravity
landfall	water vapor	NOAA	eye wall	category I



Down

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____

Across

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____

Answer Key

Preparing Posthaste

Answers will vary.

Decades of Hurricanes

1. 1940-1949
2. 1980-1989
3. 1950-1959
4. Category 1
5. Category 5
6. The average number of hurricanes per decade is approximately 17. Since 1990-1996 is not a complete decade, subtract seven from 158 for 151 total hurricanes. Divide 151 by nine for the number of complete decades and you get 16.77.
7. The average number of major hurricanes (Categories 3, 4, and 5) is approximately 7. Subtract 4 from 64 and divide the answer by 9 for an answer of 6.66.
8. The average number of hurricanes per year is approximately two. Divide 158 by 97 (number of years) for an answer of 1.63.

Comparing the Statistics

1. Texas and Florida
2. The hurricane of 1919 passed through the Florida Keys and entered the Gulf of Mexico where it strengthened and continued in a path to strike southern Texas.
3. First 50 years.
4. Florida and Louisiana
5. Hurricane Andrew first struck the coast of southeast Florida and then continued until it entered the Gulf of Mexico where it continued in a path to strike southeast Louisiana.
6. Second half of the century
7. The deadliest hurricanes occurred in the first half of the century when we did not have radar, satellites, and other technology that now warns us of approaching hurricanes long before they strike land.

Lost in a Cyclone

H S T T I T E O N O D A D R O T
U S A E D K C Y P H H D M I H R
R T T T S U T T E E P N R A E O
R L A R E U F G R A V I T Y W P
I F E F A L I H C S T W I C M I
C R P Z D T L E E S U L U M U C
A O C R B N U I N K W E R D N A
N P R H O T A S T E O W A V E L
E A I I H B C V D E M H R F T D
I V C M O S A U T S R T L F S E
L R W I O P T B M U O N W R F P
I E A L G I E B I G K A E J L R
T T M E T E O R O L O G I S T E
R A C A T E G O R Y I O S G G S
E W L O R M G O G U S T J T G S
G E O S T A T I O N A R Y B D I
E H R O R M G O G A S W J S G O
P R E D I C T S I L O I R O C N